



Light quality control

NEW

GL OPTIC SYSTEMS

Transportation Lighting Quality Control

Modern lighting technology in transportation industry uses LED sources and lamps to improve user experience and allows for more sleek and clever product design. Clear indicating LED and backlit icons as well as lamps in various shapes and sizes must be measured to ensure the color consistency, luminance or intensity values. GL offers preconfigured, individually calibrated and accurate optical performance and intuitively operated measuring instruments and a range of solutions for tests and measurements of incandescent, LED, OLED and other type of lighting products used in cars, trains and other vehicles.



Light quality control



First get to know us better

At GL we believe that the true quality innovation is about the best technology and not about gadget functionality. This is why we encourage all potential customers to choose quality instruments for their lighting product quality control.

There are many light meters available on the market today but we know what matters most for fast developing lighting manufacturers: engineering, precision, performance and equally important, independence from external quality testing labs. For many manufacturers the possibility of optimizing product quality and faster prototyping are advantageous factors helping them to win the market share.

Unlike mass produced devices, GL instruments are individually calibrated for the end user allowing for accurate and dependable results and helping to make the right product quality decisions.

Our instruments feature automatic dark current compensation combined with a temperature monitoring system which allows everyone to use the system whenever and wherever they need dependable data.

The unique plug-and-measure concept by GL features the RFID codes helping to automatically get the calibration files for each available accessory and allowing quick, easy and precise measurements of different lighting quantities. Changing from lux to lumen and even luminance values is as easy as changing the available accessories. Leave it to the system to take care of the rest.

“The ultimate light quality control systems available only for best lighting quality product manufacturers”

10 YEARS

Origins

**2009
– 2019**

GL Optic was established in 2009 to develop and bring innovative solutions in light measurement. Since its establishment GL Optic has been growing, developing products, setting industry standards and expanding sales all over the world.

Nowadays, GL Optic is at the stage of developing R&D centre and expanding its services. The company is finalizing the construction of a new photometric laboratory equipped with Poland's first black body (BB) model, the first primary standard radiation source in Central Europe.



GL OPTIC SYSTEMS

Improving light quality control

Fast changing design and increasing number of new technical solutions for In-vehicle and exterior lighting makes the quality verification a challenge for system engineers, development teams and QA/QC personnel who are dealing with modern LED, OLED and other lighting systems.

Starting from single LED emitter or OLEDs, through modules and component testing up to the final lighting assemblies, GL Optic offers comprehensive optical instrument systems for tests and measurements of any kind of lighting in transportation industry.

STOP GUESSING AND START KNOWING ALL TECHNICAL DETAILS OF LIGHTING COMPONENTS

- **Selecting better components**
- **Speeding up development**
- **Improving production testing**
- **Verification of standard compliance**
- **Maintenance under control**

Our Leadership Team



Michael Gall

CEO of Just Normlicht

co-founder of GL Optic and an open-minded entrepreneur with many years of experience in lighting technology for visual colour assessment.



Miko Przybyla

COO of GL Optic

a partner, light quality enthusiast and head of GL business development and operations.

 Light quality blog



Jan Lalek

CTO of GL Optic

co-founder of GL Optic – physicist and optical engineering expert, passionate about colorimetry, optics and modern technology.



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Automotive Lighting

Dipped beam and main beam lighting settings are the basic functions of headlamps. Modern lighting systems enable additional possibilities for light distribution modulation to improve visual performance in the traffic.

Cars, trucks, buses and specialty vehicles head lamps and signal lights must be verified to check the light distribution standard conformance.

Automotive lamps must follow the Photometric Specification of the light distribution patterns of the Economic Commission for Europe (ECE).

GL GONIOPHOTOMETER GLG A 50-1800

This A Type GONIOPHOTOMETER has been designed for R&D laboratories and product compliance testing center labs where dependable data is provided by truly user friendly photometric instrument system.



GL PHOTOMETER 3.0 LS + FLICKER Speedier lamp testing

Optimized for the On-Fly measurements of lamps on a GONIOPHOTOMETER.

High sampling rate combined with high sensitivity HAMAMATSU sensor allows for continuous (non-stop) smooth movement of the lamps.

Additional light modulation and frequency characterization is available with flicker measurement functionality.



MEASURE EXTERIOR AND IN-VEHICLE LIGHTS



- Head lamps
- Turn lights
- Daytime running lights



- Ambient interior lights



- Emergency lighting & signal warning lamps



- Tail lamps
- Backup Light
- Stop lights
- Turn lights



- Fog & driving lamps



- License plate light



Our systems support photometric tests in accordance with the following industry standards:

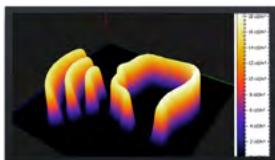
- **UN/ECE Regulation No 112** – the approval of motor vehicle head-lamps emitting an asymmetrical passing-beam or a driving-beam or both and equipped with filament lamps and/or light-emitting diode (LED) modules
- **UN/ECE Regulation No 123** – the approval of adaptive front-lighting systems (AFS) for motor vehicles
- Another requirements are described by **Federal Motor Vehicle Safety Standard (FMVSS)**, which rely on standards established by **Society of Automotive Engineers (SAE)**.

Single LEDs and COBs



GL OPTICAM 2.0 4K TEC Digital luminance camera

Presenting high performance, affordable Imaging Luminance Measuring Device for optical tests of touch screen, control panels, displays, backlit keyboards and signs.



This camera system can be paired with a spectroradiometer to measure colour.



TEST DISPLAYS



▪ Indicators & icons



▪ Display screen



GL SPECTIS 1.0 TOUCH + OPTI SPHERE 48

The **GL SPECTIS 1.0 TOUCH** light meter offers a great standalone solution, but can also be paired with a range of accessories.

Choose integrating spheres to configure the system to measure luminous flux on top of illuminance, colour.



GL SPECTIS 1.0 TOUCH



GL OPTI SPHERE 48

Railway

Lights and Lighting

Shock resistance and efficiency of LEDs is speeding up the replacement of traditional lighting used in modern locomotive and carriages. Specific design of narrow-beam, high-intensity headlights, marker lights or coupler light require specific measurements of light distribution in accordance with the industry standards.

GL GONIOPHOTOMETER GLG A 50-1800

This system can be used in factory laboratories as well as in accredited laboratories. Following the industry standards this GONIOPHOTOMETER system is ready to the testing of lamp luminous intensity distribution in H,V coordinates. Robust design, user friendly interface and top level accuracy available for fast developing industry.



GL PHOTOMETER 3.0 LS + FLICKER Speedier lamp testing

Fast and accurate measurements of lamps are possible with the On-Fly measurement mode. GL PHOTOMETER 3.0 LS + Flicker is ready for non-stop photometric tests which is speeding up the measurement procedure.

Our high sensitivity sensor improves the sampling rate, shortens the measurement time and delivers precise results.



EXTERIOR LIGHTS

Photometric measurements in accordance with **EN 15153-1:2013+A1:2016** Railway applications
- External visible and audible warning devices for trains - Part 1: Head, marker and tail lamps.



▪ **Head lights**



▪ **Marker lights**



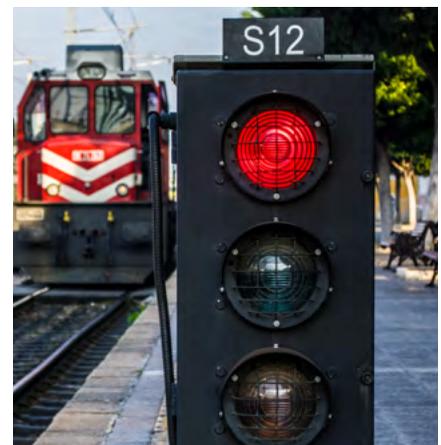
▪ **Destination signs**



RAIL SIGNALS

Signals play an important role in the safe and efficient running of railway operations. Depending on the market, specific optical, electrical and environmental tests must be performed. GL Optic provides a flexible software interface and modification options to support photometric tests of any type of signals.

▪ **Rail signals**





Single LEDs and COBs



Photometric tests provide the measurement of quantity, colour, quality and spatial distribution of light emitted by lamps, and lights in accordance with **EN 13032-1** : Light and lighting
- Measurement and presentation of photometric data of lamps and luminaires.

GL OPTICAM 2.0 4K TEC Ready-to-measure luminance camera

This high resolution and high sensitivity camera system is preconfigured for immediate luminance measurements in the laboratory, production or field application.

It enables compliance with EN ISO 9241-305:2009 Ergonomics of human-system interaction
- Part 305: Optical laboratory test methods for electronic visual displays.



DISPLAY & INTERIOR LIGHTS



▪ Displays and control panels



▪ Passenger communication displays



▪ Ambient and ceiling lights

GL SPECTIS 1.0 TOUCH + FLICKER + OPTI SPHERE 205

The **GL SPECTIS 1.0 TOUCH + FLICKER** light meter offers a great standalone solution, but it can also be paired with a range of accessories.

Choose integrating spheres to configure the system to measure luminous flux on top of illuminance, colour or flicker metrics.



GL SPECTIS 1.0 TOUCH + FLICKER



GL OPTI SPHERE 205

Aviation Lighting

High quality standards for aviation lighting systems both for safety and performance require detailed and careful product testing. Additional electrical tests and measurements together with light distribution photometric testing must be carried out.

GL GONIOPHOTOMETER GLG A 50-1800

With easy to use software, precise alignment protocols and extensive automation capabilities, the system offers a new level of performance and usability. The system uses tried-and-tested mechatronic components to provide fast, accurate and reliable measurements of aircraft lamps. Additionally, it can be used for photometric characterization of traffic signal lamps and airfield lighting systems.



GL PHOTOMETER 3.0 LS + FLICKER Speedier lamp testing

Optimized for the On-Fly measurements of lamps on GONIOPHOTOMETER.

High sampling rate combined with high sensitivity HAMAMATSU sensor allows for continuous (non-stop) smooth movement of the lamps.

Additional light modulation and frequency characterization is available with the flicker measurement functionality.



AIRCRAFT LIGHTING



AIRFIELD LIGHTS



Landing Lights



**Runway Turnoff
& Taxi Lights**



Anti-Collision Light



Position Lights

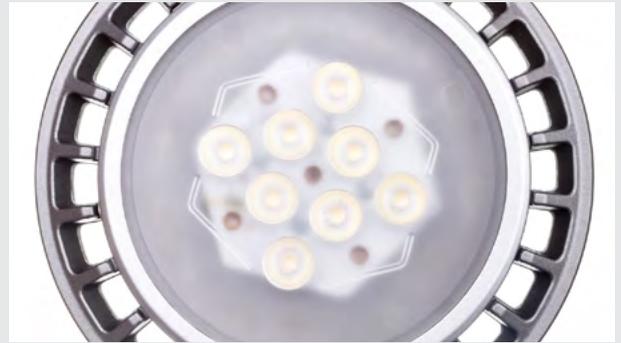


**Alternating Landing
Light System (ALLS)**





Lamps and Modules



PRECONFIGURED SETUP FOR MODULES, LAMPS AND FIXTURES

Whether you import or develop retrofit or new LED fixtures you can quickly check the performance of lighting product, verify standard compliance and control the quality of drivers and components.

- Quality control of different lamps
- Measurement of luminous flux and colour
- Energy efficiency measurement



GL OPTI SPHERE 500 + GL SPECTIS 6.0

GL OPTICAM 2.0 4K TEC Ready-to-measure luminance camera

This instrument simplifies photometric testing in accordance with **MIL-DTL-7788** which is a very common standard used for cockpit lighting displays.

The software tools help the user to check the standard compliance with the size of measurement points and measurement locations for each character on the display.



AVIONICS AND CONTROL INSTRUMENTS



- Displays and control panels



- Passenger communication displays



- Ambient and ceiling lights displays

Maritime Lights

Standard compliance in a flash

Navigation lamps must be verified in order to comply with the International Regulations for Prevention of Collisions at Sea (IMO COLREG 72). Supplementary national or regional requirements need to be followed in order to meet safety and legal requirements.

The Wheelmark for navigation lights symbolizes conformity with the Marine Equipment Directive (MED) 96/98/EC, which calls upon IMO COLREG 1972 and the norms EN 14744 (European standard for navigation lights on inland and sea-going vessels) and EN 60945 (Maritime navigation and radiocommunication equipment and systems).

GL GONIOPHOTOMETER GLG A 50-1800

Programmable, robust and accurate Type A goniophotometer with 3 mechanized H,V and Z axes and DUT moving x,y mechanical mounting table.

A preconfigured, turn-key system including all instruments with software and a dedicated PC for faster product development and improved QA/QC.



GL PHOTOMETER 3.0 LS + FLICKER Speedier lamp testing

Designed for the On-Fly measurements of lamps on GONIOPHOTOMETER.

High sampling rate combined with high sensitivity HAMAMATSU sensor allows for continuous measurement of LED during smooth movement of the lamp.



MARITIME LIGHTS

▪ Marker lights



▪ Deck Flood lights



▪ Underwater Lighting



▪ Utility lights



Masthead Lights

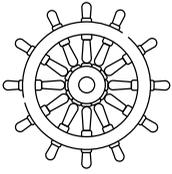


Stern or Tow Lights



Port and Starboard Side lights





Performance control and maintenance

A predominant safety requirement of EN 14744 for LED navigation lights is the monitoring and control of light output deviations caused by service life conditions.



Luminaires



COMPLETE AND AFFORDABLE SYSTEM FOR LED MODULES AND LUMINAIRES TESTING

This is the professional grade setup, powerful enough to work as a real on-site lab so you will not need to send your lamps to any external laboratories for evaluation any more. Compliant with the latest light measurement standards, the system features universal mounts and external measurement port for 2π and 4π configurations.



GL OPTI SPHERE 2000

GL OPTICAM 2.0 4K TEC Ready-to-measure luminance camera

The new GL Optic solution is ideal for a wide range of common general lighting applications, including: LED lamps and luminaires, modules, indoor and outdoor lighting.

The GL OPTICAM 2.0 4K TEC simplifies and accelerates component testing in applications ranging from vehicle displays, embedded LCD and OLED displays, instrument clusters, controls, indicators and illuminated symbols.



INTERIOR LIGHTS



▪ Ambient and ceiling lights



GL GONIOPHOTOMETER

GLG A 50-1800

Standards Compliance

The GLG A 50-1800 GONIOPHOTOMETER systems are type A systems compliant with the CIE 121-1996 and IESNA LM-75-01 standards regulating far-field photometric and colorimetric measurement systems.

Reliable and accurate

The system uses tried-and-tested mechatronic components to provide fast, accurate and reliable measurements of automotive, rail and other vehicle headlamps. Additionally, it can be used for photometric characterization of traffic signal lamps and airfield lighting systems. This GONIOPHOTOMETER system is designed for lamps of up to 50 kg and the x,y translation stage surface size is 400 x 400 mm.

Controllable and programmable

Depending on the application, the system can be paired with the following measuring instruments:

- **GL PHOTOMETER 3.0 LS + Flicker**
- **GL SPECTIS 1.3 LS**
- **GL SPECTIS 4.0**

A selection of peripheral devices for tests of vehicle headlamps is available.

**GL GONIOPHOTOMETER
GLG A 50-1800**



**SPEEDIER LAMP TESTING
GL PHOTOMETER 3.0 LS + Flicker**



TECHNICAL DATA

APPLICATION

Large LED modules and large luminaires. Compliance with the following: CIE121-1996, IESNA LM-75-01

TECHNICAL DATA SHEET

CIE Goniometer type	<ul style="list-style-type: none"> ▪ Far Field Type A with H, V axis and X, Y, Z direction movement ▪ DUT moving x,y mechanical table ▪ 5 axis servo motors with absolute position encoders
H axis movement	Angular range $\pm 100^\circ$. Nominal torque 555 Nm. Speed up to 10 °/s
H axis resolution	0.002°
H axis reproducibility	0.05° * (*at nominal load)
V axis movement	Angular range $\pm 180^\circ$. Nominal torque 98 Nm. Speed up to 50 °/s
V axis resolution	0.002°
V axis reproducibility	0.05° * (*at nominal load)
Z axis movement	Linear range 0-800 mm. Lifting capability up to 1500 N
Z axis reproducibility	70 μ m
X,Y axis movement	Linear range ± 150 mm. Speed up to 40 mm/s
X,Y axis reproducibility	70 μ m
DUT mounting plate	Square 400x400 mm. Multiple M6 mounting holes
Maximum DUT dimensions	≤ 1800 mm (symmetrically positioned)
Goniometer dimensions	1990(L) x 810(W) x 2020(H) mm
Optical axis height	1350 mm
Minimum room height	2600 mm
Minimum room width	4000 mm
Maximum load	50 kg
Goniometer weight	450 kg
Power supply	AC 110-230V, 3000 W
Controllers	<ul style="list-style-type: none"> ▪ Internal controller for all motors ▪ PC connectivity through LAN network ▪ Remote manufacturer support capability ▪ 7 inch LCD touch display on the body of goniometer ▪ Manual all axis controller for operations during DUT fixing
Safety	<ul style="list-style-type: none"> ▪ Emergency stop button on both sides of goniometer ▪ Optional safety devices with laser scanner or light fence
Sensor type	<ul style="list-style-type: none"> ▪ GL PHOTOMETER 3.0 LS + Flicker ▪ GL SPECTIS 1.0 LS ▪ GL SPECTIS 4.0
Product no.	106260

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GL OPTICAM 2.0 4K TEC

Luminance Measurement Solutions

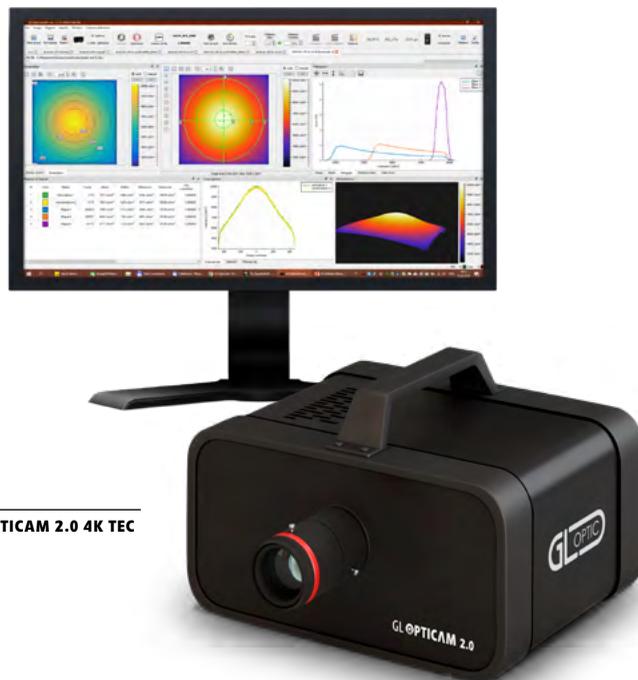
Imaging Luminance Measurement Device (ILMD) Optical digital camera system for luminance measurements of LED modules, lamps, luminaires, displays, street luminance and other sources in a broad range of applications.

What is an imaging luminance measurement device (ILMD)?

- Calibrated and optimized digital camera and optics using a CMOS image sensor
- A luminance meter with a matrix of millions of detector points
- Captures an entire scene, simultaneously measuring luminance of each point
- Rapidly measures many points in a single operation

System features

- High resolution and high sensitivity CMOS sensor
- High class V-lambda filter
- Mathematical models implemented for stray light and dark current compensation
- Flare reducing optics
- User friendly software



GL OPTICAM 2.0 4K TEC

TECHNICAL DATA

APPLICATION

Light sources, displays, luminous and illuminated surfaces

TECHNICAL DATA SHEET

Imaging resolution	4096 x 2168 (4K, 9 MPix)
A/D conversion	12 bit
Measurement range	0.01 cd/m ² ... 200000 cd/m ² (range depends on lens aperture) (ND filter for higher range available on request)
Resolution	0.01 cd/m ²
Dynamic range	1:20000000
Focus distance	200 mm to infinity (depends on lens type)
Minimum working area	56x30 mm (at 200 mm distance) (will vary depending on lens type)
Uncertainty of spectral response	Class A (f1) < 3 %
Integration time	50µs ... 30s
Measuring sensor type	CMOS monochromatic matrix with spectral response filter
Optical system	50 mm f/2.0 lens (different available on request)
Dimensions [H x W x D]	140 x 265 x 295 mm
Weight	3.5 kg
PC Connectivity	USB 3.0
Power source	15 V DC power dapter
Tripod adapter	BSW 1/4"
Case	✓
USB cable	✓
Product no.	

GL SPECTROMETERS

GL PHOTOMETER

TECHNICAL DATA



GL SPECTIS 1.3 LS



GL SPECTIS 1.0 TOUCH



GL SPECTIS 4.0 UV VIS NIR



GL PHOTOMETER 3.0
+ FLICKER



GL PHOTOMETER LS 3.0
+ FLICKER

APPLICATION

This entry level USB spectroradiometer is ideal for quick and precise light measurements.

High performance, compact self-contained spectroradiometer for immediate spectral light measurements.

High precision laboratory and industrial measurements.

TECHNICAL DATA SHEET

Spectral range	340 – 740 nm	340 – 780 nm or 640 – 1050 nm	200 – 1050 nm
Detector	CMOS image sensor	CMOS image sensor	Back-thinned type CCD
Number of pixels	256	256	2048
Physical resolution	~ 1.7 nm / ~ 1.8 nm	~ 1.7 nm / ~ 1.8 nm	~ 0.5 nm
Optical FWHM	~ 10 nm	~ 10 nm	2.5 nm
Measurement range	1 – 200.000 lx [Illuminant A]	1 – 200.000 lx [Illuminant A]	1 – 200.000 lx [Illuminant A]
Wavelength reproducibility	0.5 nm	0.5 nm	± 0.5 nm
Integration time	10 ms – 10 s in automatic mode (100 s in manual mode)	10 ms – 10 s in automatic mode (100 s in manual mode)	10 ms – 10 s in automatic mode
A/D conversion	16 bits	16 bits	16 bits
Signal to noise ratio	1000:1	1000:1	1000:1
Cosine correction	Class B – DIN 5032-7 Class AA – JIS C 1609-1:2006	Class B – DIN 5032-7 Class AA – JIS C 1609-1:2006	Class B - DIN 5032-7; Class A on demand Class AA - JIS C 1609-1:2006
Stray light	2*10 E-3	2*10 E-3	2*10 E-4
Spectroradiometric accuracy**	5 % within range 340 – 500 nm 4 % within range 500 – 780 nm	5 % within range 340 – 500 nm 4 % within range 500 – 780 nm	6 % within range 200 – 220 nm 5 % within range 220 – 500 nm 4 % within range 500 – 1050 nm
Measurement uncertainty of colour coordinates (x,y)**	0.0015	0.0015	± 0.0015
PC interface	USB 2.0 standard	USB 2.0 standard	USB 2.0 standard
Display full colour	–	240 x 320 px	–
WiFi	–	802.11b/g	–
Micro SD card	–	4GB	–
Power	Power USB	lithium-ion battery 1400 mAh	Power USB
Ambient temperature	5–35°C	5–35°C	5–35°C
Dimensions	72 mm x 115 mm x 19 mm	74 mm x 146 mm x 24 mm	70 mm x 170 mm x 204 mm
Weight	120 g	315 g (< 1 pound)	1500 g
Product no.	67827	106260	

Spectral range of the sensor. Actual spectral range of system may be reduced due to limitations of used optical accessory.
** Absolute measurement uncertainty immediately after calibration. The expanded uncertainty corresponds to a coverage probability of 95 % and the coverage factor $k = 2$.

Parameters valid in laboratory conditions 25deg C , relative humidity 45%.

Black Body radiator model was used as a reference source. Standard spectroradiometric irradiance measuring probe was used in a fixed position against the radiator during the entire test.

APPLICATION

High quality flicker measurements including long term sampling, integrating sphere photometer, high precision illuminance measurements or to be used as standalone device.

High quality flicker measurements including long term sampling, goniometric high precision illuminance measurements or to be used as standalone device.

TECHNICAL DATA SHEET

Measurement range	0.001 lx ... 10 000 000 lx*	0,0001 lx ... 1 000 000 lx*
Resolution	4 significant digits	4 significant digits
Uncertainty of spectral response (f1')	Class A < 3 %	Class A < 3 %
Uncertainty of cosine correction (f2')	A < 1,5 %	–
Sampling frequency	125 kHz	125 kHz
A/D conversion	18 bit	18 bit
Software	GL Spectrosoft or API for external software developers	GL Spectrosoft or API for external software developers
Dimensions [H x W x D]	110 x 66 x 53 mm	110 x 66 x 53 mm
Weight	350g	350g
Connectivity	USB A-B	USB A-B
Power	USB, 5V <200mA	USB, 5V <200mA
Tripod adapter	¼"	¼"
Case	✓	✓
USB cable	✓	✓
Product no.	202295	202294

* standard measuring range can be extended by customization

GL OPTI SPHERES

TECHNICAL DATA



GL OPTI SPHERE 48



GL OPTI SPHERE 205



GL OPTI SPHERE 500



GL OPTI SPHERE 2000

APPLICATION

Luminous flux and radiant power measurement of single LEDs and other small light sources.
Mounts directly on spectrometer.

Luminous flux and radiant power measurement of LEDs and other light sources.

Luminous flux and radiant power measurement of LED modules and retrofit lamps.

Luminous flux and radiant power measurement of large LED modules and large luminaires.

TECHNICAL DATA SHEET

Spectral range	340 – 1700 nm			
Sphere inner diameter	48 mm	205 mm	500 mm	2000 mm
Sphere material	Aluminium	Aluminium	Composite	Carbon steel
Inner coating	Barium Sulfate (BaSO ₄) high-reflectance material (R98)	Barium Sulfate (BaSO ₄) high-reflectance material (R98)	Barium Sulfate (BaSO ₄) high-reflectance material (R98)	Barium Sulfate (BaSO ₄) high-reflectance material (R98)
Outer coating	Black textured finish	Black textured finish	Black finish	Black textured finish
Reflectance properties	97%	97%	97%	97%
Auxiliary light source	N/A	White LED	White LED	White LED or halogen
Spectrometer port	Direct connection	Direct connection or SMA fiber-optic	Direct connection or SMA fiber-optic	Direct connection or SMA fiber-optic
Standards compliance	N/A	CE LM 79 CIE 127:2007 CIE S 025/E:2015	CE LM 79 CIE 127:2007 CIE S 025/E:2015	CE LM 79 CIE 127:2007 CIE S 025/E:2015
Maximum DUT dimensions in accordance with CIE S 025/E:2015	N/A	20 mm (diameter or diagonal)	50 mm (diameter or diagonal)	200 mm (diameter or diagonal)
Maximum dimension for optimal measurement (1/3 x sphere diameter)	N/A	65 mm (diameter or diagonal)	165 mm (diameter or diagonal)	665 mm (diameter or diagonal)
Maximum DUT weight	N/A	250 g	3 kg	25 kg
Sphere frame	N/A	N/A	Hinged	Hinged
Sphere center positioning	N/A	N/A	N/A	Cross laser mechanism
Mechanical breadboard with post	N/A	For 4 π measurement	For 4 π measurement	For 4 π measurement
USB source controller for auxiliary light source	N/A	With current source and relay switch for external power supply	With current source and relay switch for external power supply	With current source and relay switch for external power supply
Universal post with standard lamp sockets	N/A	N/A	E14, E27, GU10 and G4 for QTH lamp spectral flux source	Universal DUT fixing table (breadboard) for measurement in 4 π geometry
External dimensions [W x H x D]	52 x 88 x 51 mm	265 x 270 x 225 mm	620 x 760 x 590 mm	2200 x 2200 x 2300 mm
Weight	0.126 kg	3.3 kg	17.5 kg	420 kg

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Light quality control



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- - Resellers
- - Clients

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